

REMARKS

After entry of this amendment, claims 1, 3-8, 10-17 and 19-23 will be pending. Claims 15-17 stand rejected under 35 U.S.C. 112, second paragraph, for indefiniteness. Claims 1, 3, 4, 6-8, 10, 11, 13 and 14 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Umezu et al. (U.S. Patent No. 5,862,163) in view of Narusawa et al. (U.S. Patent No. 6,033,223). Claims 2, 9 and 15-17 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Umezu and Narusawa, and further in view of Hargis et al. (U.S. Patent No. 6,101,201). Claims 5 and 12 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Umezu and Narusawa, and further in view of Fermann et al. (U.S. Patent No. 5,880,877). Claim 18 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Umezu and Narusawa, and further in view of Moulton (U.S. Patent No. 5,740,190).

Rejection of Claims 15-17 Under 35 U.S.C. 112, Second Paragraph

Claims 15-17 stand rejected under 35 U.S.C. 112, second paragraph, for indefiniteness. In particular, the claims are rejected for providing no structure to accomplish the cooling cited in the claims. Claim 15 has been amended to include a limitation directed at a means of cooling the cesium lithium borate crystal. Accordingly Applicants request the withdrawal of the rejection under 35 U.S.C. 112, second paragraph.

Rejection of Claims 1, 3, 4, 6-8, 10, 11, 13 and 14 Under 35 U.S.C. 103(a)

Claims 1, 3, 4, 6-8, 10, 11, 13 and 14 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Umezu in view of Narusawa.

Umezu teaches a frequency-quadrupled 1064nm laser. Narusawa teaches a dental process using a photo-polymerization material and a laser beam of 350 to 500 nm.

The Office Action notes that Umezu discloses frequency doubling the output of a Nd:YAG laser to produce a second harmonic beam and frequency doubling the second harmonic beam to produce a fourth harmonic beam using a CLBO crystal oriented for non-critical phase matching. The Office Action cites Narusawa for teaching that Nd:YAG lasers with an output of approximately 946 nm are known to be used in frequency doubling devices. The Office Action goes on to state that it would have been obvious to substitute the laser of Narusawa for the laser in Umezu “because the use of the different laser will not change the operation of the device, only

the output wavelength and thus the lasers are art-known substitutes”. Applicants strongly disagree.

Applicants submit that many of the presently claimed limitations are neither taught nor suggested by the prior art. In particular:

(1) The cited art does not teach or suggest the use of non-critically phase matched CLBO as stated in the Office Action. Umezu only teaches the use of non-linear crystals to achieve the desired frequency conversion.

(2) The cited art does not teach or suggest that CLBO can be used to achieve an output wavelength of 236.5 nm. Umezu only teaches that CLBO can be used to output light at wavelengths of 266 nm, 357 nm or 532 nm.

(3) The Office Action states that the use of different lasers will not change the operation of a frequency doubling system (page 3, first paragraph). Applicants respectfully submit that this statement is incorrect. It is well known by those of skill in the art that changing lasers may dramatically affect the operation of a frequency doubling system. First, specific nonlinear crystals are only useful with specific lasers/wavelengths. Second, the efficiency of a system will vary greatly, depending upon the specifics of the laser/frequency conversion system in use. Additionally, Applicants note that Narusawa only teaches that a Nd:YAG laser, tuned to a wavelength of 946 nm, can be frequency doubled to achieve an output of 473 nm. Narusawa (or any other cited reference) does not teach or suggest that the 473 nm output can be frequency doubled to achieve a fourth harmonic, nor does Narusawa (or any other cited reference) teach or suggest the use of CLBO to frequency double the 473 nm output.

Applicants submit that none of the cited art teaches or suggests that the output of a frequency doubled Nd:YAG laser with an output wavelength of 946 nm can be frequency doubled to achieve an output of 236.5 nm. Additionally, Applicants submit none of the cited art teaches or suggests that CLBO can be used to frequency double a 473 nm beam. Lastly, Applicants submit that none of the cited art teaches or suggests the use of non-critically phase-matched CLBO. Accordingly, Applicants request the withdrawal of the rejection of independent claims 1, 8 and 15 and all claims that depend therefrom (i.e., claims 3-7, 10-14, 16-17 and 19-23).

Rejection of Claims 2, 9 and 15-17 Under 35 U.S.C. 103(a)

Claims 2, 9 and 15-17 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Umezu and Narusawa, and further in view of Hargis. Claims 2 and 9 have been canceled and therefore the rejection of these claims is moot.

For the reasons provided above, Applicants submit that claims 15-17 are distinguishable and patentable over the prior art. With respect to the contention given in the Office Action that determining the optimum temperature of the CLBO crystal would only require routine experimentation, Applicants strongly disagree.

In determining the optimum temperature of a non-linear crystal, Applicants submit that there are two variables that must be considered; phase matching angle and temperature. Because there are two variables, not simply a temperature variable as suggested in the Office Action, there is an infinite number of combinations that must be explored in order to determine the optimum non-linear conversion process. Therefore more than just routine experimentation is required to determine this optimum point.

Applicants respectfully submit that prior to this invention, it was not known that CLBO could be used to uniquely phase-match frequency-quadrupling of the 946 nm Nd:YAG laser. Nor was it known prior to this invention that the most efficient frequency-quadrupling point, corresponding to non-critical phase-matching, occurs at a temperature of between -10°C and -20°C, and more specifically at a temperature of -15°C. Neither Umezu nor Narusawa disclose using cooled CLBO. Hargis only teaches that longitudinal cooling allows the temperature of the non-linear crystal to be maintained closer to the optimum phase matching temperature across the mode volume of the laser beam (col. 13, lines 3-7). Hargis goes on to state that this is “important due to the finite phase matching temperature acceptance of certain frequency conversion processes in nonlinear crystals” (col. 13, lines 7-9). As stated elsewhere in Hargis, longitudinal cooling reduces thermal gradients within the non-linear material (col. 2, lines 52-54). Hargis never discloses cooling the non-linear crystal in order to accomplish anything other than achieving more uniform temperature distributions within the non-linear crystal. Nor does Hargis ever disclose the use of CLBO.

Applicants also note that due to the hygroscopic nature of CLBO crystals, it would not be obvious to use these crystals at anything other than an elevated temperature.

As none of the cited art teaches or suggests using cooled CLBO much less CLBO cooled to a temperature of between -10°C and -20°C, Applicants respectfully submit that independent claims 1, 8 and 15 and all claims that depend therefrom (i.e., claims 3-7, 10-14, 16-17 and 19-23) are novel and patentable over the cited prior art. Additionally Applicants submit that these claims are novel and patentable over the cited art for the reasons cited in the previous section. Accordingly, Applicants request the withdrawal of the rejection of these claims under 35 U.S.C. 103(a).

Rejection of Claims 5 and 12 Under 35 U.S.C. 103(a)

Claims 5 and 12 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Umezu and Narusawa, and further in view of Fermann.

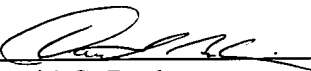
Claims 5 and 12 depend from claims 1 and 8, respectively. Therefore for the reasons provided above, Applicants submit that these claims are novel and patentable over the cited art and therefore request the withdrawal of the rejection under 35 U.S.C. 103(a).

Rejection of Claim 18 Under 35 U.S.C. 103(a)

Claim 18 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Umezu and Narusawa, and further in view of Moulton. As claim 18 has been canceled, this rejection is moot.

In conclusion, Applicants submit that all pending claims are in condition for allowance. If in the opinion of the Examiner, a telephone conference would expedite the prosecution of the subject application, the Examiner is invited to call the undersigned at (415) 393-2404.

DATE: 12/15/03 Respectfully submitted,

By: 
David G. Beck
Registration No.: 37,776

Bingham McCutchen, LLP
Three Embarcadero Center, Suite 1800
San Francisco, California 94111
Telephone: (415) 393-2000 Telefax: (415) 393-2286